AUTOMOBILE REGISTRATION AND INSPECTION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates in general to an improved object identification system, and in particular to an improved mobile object identification system. Still more particularly, the present invention relates to an improved apparatus and method for automatic identification and verification of vehicle compliance, such as the registration, inspection, and insurance status of automobiles.

2. Description of the Prior Art

To maintain safe public roadways, automobiles are required to comply with laws regarding vehicle registration, state inspection, and liability insurance requirements. Each automobile must be identified as to its current status of compliance with these laws. Present identification systems utilize adhesive decals that are affixed directly to the vehicles. Vehicle owners and operators are typically required to replace inspection and registration decals on their vehicles every year to keep them in compliance with the laws.

The decals are serialized, dated, and color-coded for ease of visual detection by mobile or stationary inspectors such as law enforcement personnel. When mobile inspectors are in transit, they have some difficulty reading and verifying the status of the decals and, thus, enforcing the laws requiring them. This lack of enforcement has allowed vehicle operators to abuse the inspection, registration, and insurance laws such that some vehicles are unsafe for roadway use. An improved method and apparatus for inspecting vehicle compliance with roadway safety laws is needed.

SUMMARY OF THE INVENTION

The present invention is directed to a method and apparatus for object identification, which includes an electronic mobile reader, base unit, an electronic vehicle transponder and electronic personal access tags. In one embodiment, the electronic mobile reader interrogates the electronic vehicle transponder with an RF (radio frequency) poll allowing the electronic vehicle transponder to backscatter an RF signal containing electronic personal access tag identification to the electronic mobile reader. The electronic mobile reader demodulates the signal and sends the electronic personal access identification to the base-unit where it identifies the status of the personal access tags that were inserted into the electronic vehicle transponder. The electronic personal access identification may be as simple as verifying the expiration data. No database search is necessary to evaluate the expiration data. The electronic personal access identification sent to the electronic mobile reader is compared to the current date for each electronic personal access tag stored in the electronic vehicle transponder memory. In one embodiment, either a red or green light illuminates indicating the noncompliance or compliance, respectively, of the electronic personal access identification of each electronic personal access tag received by the electronic mobile reader.

Each electronic personal access tag contains memory that is downloaded to the electronic vehicle transponder at the time the electronic personal access tag is inserted into the electronic vehicle transponder. An indicator will alert the user that the sequence has been completed successfully and, at that moment, the user will remove the electronic personal access tag from the electronic vehicle transponder. Electronic personal access tag memory will be rendered useless upon removal of electronic personal access tag from the electronic vehicle transponder if the data transfer was successful. In one embodiment, the electronic personal

access tag and the electronic vehicle transponder utilize an encryption scheme to eliminate fraud or misuse of the electronic personal access tag.

In another embodiment of the present invention, the electronic vehicle transponder utilizes an anti-theft/tamper proof scheme to render the transmitter circuitry useless if it is removed from the vehicle. An electronic personal access tag key is inserted into the electronic vehicle transponder to reactivate the transmitting circuits. The personnel electronic personal access tag key is be unique to that electronic vehicle transponder and can have an encryption scheme to eliminate fraud or theft. The electronic personal access tag key makes the electronic vehicle transponder virtually worthless to individuals that may want to remove them from vehicles.

The base-unit receives electronic personal access identification data from the electronic mobile reader and alerts the user to the status of the electronic vehicle transponder being interrogated. In one version, the base-unit utilizes green and red indicator lights to signify good and bad inspection, registration, insurance or any combination. In addition, the base-unit may be included in the electronic mobile reader.

The electronic vehicle transponder is an electronic device with on-board memory and, preferably, an encryption scheme. The electronic personal access tag is a contact smart card approximately half the size of a credit card. The smart card is inserted into a slot on the electronic vehicle transponder. The contacts on the smart card engage contacts inside the electronic vehicle transponder to provide power to the smart cards and start a flashing green indicator on the electronic vehicle transponder. When the data is transferred from the smart card memory to the electronic vehicle transponder memory, a solid indicator illuminates acknowledging the status of the data transfer. The electronic vehicle transponder will not start

transmitting the information until the electronic personal access tag is removed from the slot.

The foregoing and other objects and advantages of the present invention will be apparent to those skilled in the art, in view of the following detailed description of the preferred embodiment of the present invention, taken in conjunction with the appended claims and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the manner in which the features, advantages and objects of the invention, as well as others which will become apparent, are attained and can be understood in more detail, more particular description of the invention briefly summarized above may be had by reference to the embodiment thereof which is illustrated in the appended drawings, which drawings form a part of this specification. It is to be noted, however, that the drawings illustrate only a preferred embodiment of the invention and is therefore not to be considered limiting of its scope as the invention may admit to other equally effective embodiments.

Figure 1 is a perspective view of a presenting unit with two programmable cards inserted therein and is constructed in accordance with one embodiment of the present invention;

Figure 2 is a front elevational view of the presenting unit and programmable cards of **Figure 1**;

Figure 3 is a side view of the presenting unit and programmable cards of **Figure 1**;

Figure 4 is a front elevational view of one of the programmable cards of **Figure 1**;

Figure 5 is a perspective view of a detector of the present invention;

Figure 6 is a front elevational view of the detector of **Figure 5**;

Figure 7 is a side view of the detector of **Figure 5**;

Figure 8 is a schematic diagram illustrating an embodiment of the present invention installed in an automobile and a law enforcement vehicle;

Figure 9 is a block diagram of the presenting unit of **Figure 1**; and

Figure 10 is a block diagram illustrating a preferred embodiment of the entire system of the present invention and the relationship between its major components.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to **Figures 1-7**, an automobile registration and inspection system comprises a presenting unit **10**, a detector **12**, and programmable information cards **14**. As shown in **Figure 1**, the presenting unit **10** is a device of nominal thickness and dimensions with a front side **16** and back side **18**. Slots **20** on the top of the presenting unit **10** allow the insertion of programable information cards **14**. The slots **20** are aligned horizontally but they may be stacked one behind the other allowing the presenting unit **10** to be narrower in width. The presenting unit **10** secures to an automobile windshield or other structure in a way that prevents removal and tampering by someone other than the owner of the automobile. In one version, the presenting unit **10** accepts a vehicle registration card **22** and a vehicle inspection card **24**, as shown in **Figure 2**. However, the presenting unit **10** could also be used with other cards **14** containing information such as vehicle insurance, etc.

The detector **12** of the present system is a device located a distance away from the presenting unit **10**, preferably in a law enforcement vehicle **60**, as shown in **Figure 8**. Detector **12** in law enforcement vehicle **60** is used to monitor and inspect the cards **14** in presenting unit **10**, which may be mounted in, for example, a passenger vehicle **62**. Referring to **Figures 5-7**, the detector has a front panel **26** containing indicators **28**. Indicators **28** may be in the form of light-emitting elements (e.g., light-emitting diodes or laser diodes) to show a "good" (in compliance) or "bad" (noncompliance) signal has been processed for each type of interrogation (e.g., registration, inspection, etc.), as shown in **Figure 6**. Alternatively, a textual indicator or other sensory means may be used as well. An audible selector **30** allows the operator to choose whether one receives an audible signal in addition too or instead of the indication given on the front panel **26**. The detector **12** reads the signal emitted by the presenting unit **10** and provides a

comprehendible indication to the operator of the detector **12**. Many types of signals may be used by the presenting unit **10** and detector **12** such as infrared signals, radio frequencies (RF), radar technology, satellite tracking, cellular or digital signals, and/or microwave frequencies. The projection selector **32** on the detector **12** allows acceptance of signals from the front or back or both sides of detector **12**. In one version, the system functions at a minimum range of about 60 feet.

Referring now to **Figure 9**, there is depicted an embodiment of a presenting unit **10**. Presenting unit **10** includes a registration card reader **34a** and an inspection card reader **34b** that are utilized to extract the information stored on vehicle registration card **22** and vehicle inspection card **24** (see **Figures 1-2**). It should be apparent to those skilled in the art that the type of registration and inspection card readers **34a, 34b** utilized are dependent on the encoding methodology employed in writing data onto the vehicle registration and inspection cards **22, 24**. Thus, if the vehicle's information are encoded on a magnetic strip, for example, registration and inspection card readers **34a, 34b** are conventional magnetic card readers. The present invention does not contemplate limiting its practice to any one particular encoding scheme. For example, in another advantageous embodiment, the data may be encoded using bar codes and, consequently, registration and inspection card readers **34a, 34b** are conventional optical bar code readers.

To prevent the use of vehicle registration and inspection cards **22, 24** on other vehicles for which they are not authorized, registration and inspection card readers **34a, 34b**, may, after the cards are inserted into presenting unit **10** for the first time, erase the information on the cards, thus invalidating and precluding the use of the cards with any other automobile. Alternatively, in another embodiment, registration and

inspection card readers **34a, 34b** may add an additional piece of information on the cards to indicate that the cards have been associated with a particular automobile. Still other security measures also may be employed to prevent misuse of the system.

Again referring to **Figure 9**, a controller **36**, such as conventional microprocessor, is coupled to registration and inspection card readers **34a, 34b** and to an RF transponder **38**. Controller **36**, in an advantageous embodiment, utilizes its internal clock to time-stamp the first insertion of vehicle registration and inspection cards **22, 24** into presenting unit **10**. Generally, the information contained on vehicle registration and inspection cards **22, 24** and the time stamp are saved in a registry file within the memory of controller **36**. This allows controller **36** to periodically check the recorded time-stamp, at predetermined intervals, to determine if the cards have "timed out," i.e., expired, e.g., after one year.

RF transponder **38** is a conventional transponder that is tuned to transmit only at two predetermined frequencies corresponding to the "good" and "bad" signals discussed previously. Controller **36** selectively switches RF transponder **38** to emit the good or bad signal based on information retrieved by registration and inspection card readers **34a, 34b** as described above. The good or bad signal is transmitted by presenting unit **10** utilizing an antenna **40** coupled to RF transponder **38** that, in a preferred embodiment, is a directional antenna. Alternatively, in another advantageous embodiment, antenna **10** may include both an omnidirectional (isotropic) antenna, such as a whip antenna, and a directional antenna, such as a Yagi or micro strip patch. Also shown in the illustrated embodiment, is a power supply **42**, such as battery or an adapter to the automobile's battery, that provides power to registration and inspection card readers **34a, 34b**, controller **36** and RF transponder **38**.

In operation, a law enforcement official in a law enforcement vehicle **60** (**Figure 8**) positions the audible selector **30** and projection selector **32** of detector **10** in desired positions. As an automobile **62** with a presenting unit **10** in place comes into range of the detector **12**, the detector **12** analyzes the emitted signal and produce a reading on the front panel **26**. In another version of the present invention, the detector **12** may be incorporated into a police radar detector gun.

A block diagram of a further embodiment of the present invention illustrating the relationship between the major components of the system is shown in **Figure 10**. The electronic personal access tag **200** allows the vehicle owner and/or an associated organization to download data into the electronic vehicle transponder **300** (an alternate version of presenting unit **10**). The electronic personal access tag **200** is a contact smart card **530** (an alternate version of one of the cards **14**) with limited memory **210**. The memory **210** contains, for example, information that identifies the vehicle owner, the type of registration tag, and expiration date(s). The information identifying the vehicle owner may be but is not limited to the license plate number of the vehicle. Vehicle transponder **300** verifies that the correct electronic personal access tag **200** is being used with an authorized electronic vehicle transponder **300**, allowing the electronic personal access tag **200** to download data. If the vehicle owner's identification does not match, the download process will not take place (a proper match may be determined, for example, with reference to the vehicle's unique vehicle identification number). In addition, an indicator light illuminates on the electronic vehicle transponder **300** as to the status of the download. After memory **210** of personal access tag **200** successfully downloads its contents, vehicle transponder **300** initiates a process to render electronic personal access tag memory **210** useless. This will effectively prevent unauthorized use of personal access tag **200**. The transaction between the

electronic mobile readers and the electronic personnel access tag will be protected by an encryption scheme **220** to prevent fraud and/or misuse.

Expiration date and tag type identifies the particular organization to which the electronic personal access tag **200** was issued, and the date on which the personal access tag **200** expires. In one version of the present invention, each organization that issues registrations and inspections, and/or private insurance company is capable of issuing electronic personal access tags **200** to authorized users.

Referring again to **Figure 10**, the electronic vehicle transponder **300** is a self-contained unit comprising an RF-detector, RF-demodulator **330**, microcontroller **320** with non-volatile memory **310**, and antenna **350**. It uses wireless backscatter modulation **340** technology to respond to RF signals transmitted from the 915 MHz antenna **350** assembly by reflecting and modulating the received RF signal. In one version, the downlink **520** interrogation from the electronic mobile reader **100** (an alternate version of detector **12**) operates at 915MHz, horizontally polarized, modulation **140** method amplitude shift keying, and the modulation **140** pattern is continuous wave.

The electronic vehicle transponder **300** detects the 915 MHz field and demodulates the signal. If the modulation **340** is correct, the transponder starts to backscatter modulate. The backscatter modulation **340** radar cross-sectional area is, in one version, a minimum of 50 square centimeters, backscatter encoding subcarrier type, subcarrier frequency 500 kHz, subcarrier modulation **340** two phase shift keying, subcarrier data encoding is differential, and subcarrier data speed is 125 bits per second. The data sent to the mobile reader contains, for example, the vehicle owner's identification, expiration date, and tag type.

The electronic mobile reader **100** is a two-watt amplitude shift keyed transmitter **110** homodyne receiver operating in the 909.75 to 921.75 MHz band. In the downlink **520** mode, filtered Manchester-coded data shifts the transmitter between two power levels differing by more than 25 dB at a 300 kbps signaling rate. In the uplink **510** mode, the electronic reader transmits an unmodulated carrier at approximately 916 MHz, and the electronic vehicle transponder **300** amplitude modulates the reflected signal with one of two frequencies, 600 kHz or 1200 kHz, to encode the uplink **510** binary data. The electronic mobile reader's **100** homodyne receiver down converts **160** the 600 kHz or 1200 kHz modulation **140** tones to base band filters and removes amplitude variation from the frequency shift-keying signal. The transceiver homodyne transmitter transmits two different types of signals, amplitude modulated downlink **520** signal to send data to the electronic vehicle transponder **300** and an unmodulated carrier to illuminate the tag for the backscatter modulation **340** uplink **510** mode.

The electronic mobile reader **100** can multiplex two transmitter and receiver channels. These channels are connected to two antenna pairs **150** that allow the mobile user to read forward and aft electronic vehicle transponder **300**. The electronic mobile antenna **150** allows for a directional read zone to accommodate highway and rural speed requirement. The power of the mobile reader can be adjusted to control read zone distances. Yagi, dipole and patch array antennas **150** are utilized to accomplish the wide variety of read zone requirements.

The electronic mobile reader **100** compares the data received from the electronic vehicle transponder **300** and performs a simple microprocessor **130** and memory **120** comparison of the expiration date for each electronic personal access tag **200** type to the present date. This comparison activities an algorithm for each tag type and sends a digital

signal **500** to the base-unit **400** to illuminate the correct user indicator **410**.

The automobile registration and inspection system provides several advantages. The invention is adaptable to be used in application not only with automobiles but also marine craft, water craft, air craft or motorcycles. Likewise, the practicability and ease of operation of programmable information cards permit the distribution by a licenced agency and installation by the public. Also, the detector does not require the use of a database to compare and analyze the received signal. The system may be completely independent of any on-board computers in the vehicles.

While the invention has been shown or described in only some of its forms, it should be apparent to those skilled in the art that it is not so limited, but is susceptible to various changes without departing from the scope of the invention.